

Topic 1: *Effects of Spartina invasion on the Humboldt Bay Ecosystem.*

Overall Question: What are the current and potential future impacts of *Spartina*'s presence in Humboldt County that have not already been discussed today?

Discussion notes:

Spartina doesn't appear to extirpate natives, but displaces them

Does *Spartina* dominance go from herbivore to detrital food web? (i.e. does it alter the food web?)

The association between invertebrates and plant communities- *Spartina* dominated vs. natives- has not been studied for Humboldt Bay. Has it been studied elsewhere?

Economic impacts of eradication/control of *Spartina* for Humboldt Bay could be significant. What are the costs of doing nothing?

What is the role of *Spartina* in delta formation and its relationship to sedimentation?

HB population as a source of cordgrass invasions- what was or is the source of transport?

Question 1: What are the current impacts of *Spartina*'s presence in Humboldt County? How would you rank these impacts? (Very Important, Moderately Important, Not Important)

Here is a list of current *Spartina* impacts in Humboldt County already discussed today to get you started thinking about this question:

Impact	Rank
1. Outcompetes indigenous plant species	
2. Alters wildlife habitat	
3. Alters estuarine food web	
4. Threatens estuarine restoration projects	
5. Source for cordgrass invasions of other areas	LOW

Question 2: What are potential future impacts of *Spartina*'s presence in Humboldt County? (e.g. possible future colonization of mudflats, terrestrial areas, brackish and freshwater areas)

Impact	Rank
1. Colonization of mudflats	
2. Colonization of brackish marsh	
3. Colonization of freshwater marsh	

4. Colonization of terrestrial areas

Question 3. What are the key uncertainties regarding *Spartina*'s impacts that research should address?

Top three priorities:

1. Sedimentation and circulation dynamics
2. Accretion or not with *Spartina* presence or eradication- SET tables
3. Risk of having a hybrid show up here

Primary Productivity- need to study which species is contributing what amount of carbon.

How does current salt marsh compare with what was present in HB?

How do detrital pathways function and what is contribution of different species?

Isotope studies (could contribute to determining contribution of specific species to food web- esp. carbon)

Look at bird diversity and use of salt marsh- *Spartina* now.

Study infaunal biomass.

What do we know about *Spartina* in its native habitat? Why is it invasive here?

Determine if *Spartina* is found at wider elevation range than when Annie Eicher did her study in 1987

Ongoing restoration projects should evaluate the potential for *Spartina* invasion. If invasion occurs, monitor to determine how and why it occurred.

Does *Spartina* change relative abundance of habitats in the Bay?

Is there a potential for exponential growth beyond current extent?

Important to monitor now- determine if there is a relationship to climate change (in terms of expanding extent, or preventing inundation through sea level rise?)

What is the effect of the species on carbon sequestration?

Topic 2: *Environmental Impacts of Spartina Eradication Activities.*

Overall Question: What are the short and long term impacts of *Spartina* eradication not already discussed today? Do the potential long-term benefits of *Spartina* eradication outweigh the impacts and costs of eradication activities? What do we need to know to answer this question with enough confidence to move forward?

Question 1: What are the anticipated short term impacts of regional *Spartina* eradication? How could these impacts be minimized?

Here is a list of potential *Spartina* eradication techniques that have been used on the west coast to get you started thinking about this question. A combination of these techniques could potentially be used. For each technique, think about the potential environmental impacts to plants, wildlife, water quality, people, etc. Discuss ways that these impacts could be minimized.

1. Mowing with hand tools (rotary cutters with blades)
2. Flaming with hand torches
3. Controlled burning
4. Crushing/tilling with tracked vehicles
5. Hand-digging
6. Covering with plastic
7. Flooding and draining with temporary inflatable dikes
8. Herbicide application (probably with imazapyr)
 - a. With hand sprayers
 - b. Aerial from helicopter

Here are some impacts that were discussed today. Please add to the list and rank these impacts.

Eradication Impact	Technique(s)	Rank
1. Increased erosion/turbidity	All	
2. Wildlife disturbance	All- greater with techniques involving many repeat visits	
3. Temporary habitat loss	All	

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|-------------------------------|------------|
| 4. Public health concerns | Herbicides |
| 5. Non-target plant mortality | All |

Question 2. What are potential long term impacts of Spartina eradication? Consider possible impacts to plants, wildlife, water quality, people, and anything else you can think of. Rank these impacts. Here is a list of potential impacts of eradication to get you started:

Eradication Impact	Rank
1. Reduced sediment accretion=increased turbidity	
2. Reduced primary productivity	
3. Loss of habitat for wildlife that prefer <i>Spartina</i>	
4. Restoration of native plant communities, estuarine food web, and wildlife habitat	
5. Reduces obstacles to marsh restoration projects	
6. Reduces risk of <i>Spartina</i> colonization of West Coast marshes	

Question 3. What are the key uncertainties regarding *Spartina* eradication impacts that research should address?

Look at what should be done with wrack if *Spartina* is mowed. Could it be composted? Is there some use for it? It is currently burned onsite at the refuge. In San Francisco Bay, sometimes wrack is allowed to be flushed out by the tides after it has been sprayed with imazapyr. In other areas, it piles up. A large amount of wrack is produced by live *alterniflora* and *densiflora*, as well as by control efforts.

Wrack could fuel mosquito production and could contribute to raising elevations locally.

Important to map *Spartina* in the Eel River estuary and the Mad River

Herbicide use needs to be examined- there are lawsuits in the Delta and regarding imazapyr use in the Eel for purple loosestrife- there are questions about the long term persistence of imazapyr. Brenda Grewell reports 4 years with no vegetation recruitment in some riparian areas where imazapyr was used. The San Francisco Bay Invasive *Spartina* EIR/EIS evaluated use of

glyphosate and imazapyr and found it resulted in lower environmental impacts than mechanical control techniques.

It is possible that densiflora won't respond well to herbicide use because of its rolled leaves. It hasn't responded well yet in Corte Madera, but this may be because of poor application techniques.

The eradication efforts should keep the end goal of restoration in mind- don't use techniques leading to long-term loss of function.
Do control techniques affect biogeochemical functioning?

Need to look at herbicide impacts on amphibians (CRLF present on margins of marsh).

What are the impacts on the Bay ecosystem of passing through the bare mud and algal mat stages?

The smaller extent of the invaded area in HB allows more options than SF Bay and Willapa Bay (e.g. mechanical control?).

One possible approach would be to mow 200 ac/yr. But would need to control seed production at the same time.

It would be helpful to know about densiflora's seed longevity and whether a seed bank is present. It would also be helpful to understand local patterns of seed dispersal in order to prioritize control from "upstream" to "downstream".

Would all 900 acres need to be sprayed or mowed at once to minimize seed production? Would it have to be mowed more than once to reduce seed production? A sublethal spray could be used to reduce seed set, but this could select for herbicide resistance.

Need to examine natural history of densiflora and its pattern of biomass accumulation throughout the year.

In terms of time of year, HB would probably have no species restrictions on spraying (although CRLF may possibly be an issue). Mowing was tried in HB at different times. Burning with a handheld torch only works on small seedlings.

Mechanical techniques would be expected to have short term impacts from soil compaction on inverts and insects. Also turbidity.

Could grazing be used to control seeds? But water quality impacts from livestock waste would be a problem.

Would toxic contamination of soils be an issue, at least near old industrial sites?

Mechanical techniques could create predator pathways that would facilitate increased activity by foxes and coyotes that could impact other wildlife (birds, amphibians).

Birds in HB salt marshes are wide ranging and common, while rare plants are not. The host community of the rare plants needs to be maintained. There will need to be monitoring to measure the effects of the control program on these rare plant species.

Large scale aerial spraying of mid- to low-marsh might not make sense because you would lose native relict plants under Spartina or amongst the Spartina.

Sediment trapping- may be higher in densiflora than in natives. Would removing densiflora result in greater turbidity? Maybe not- possibly sediment would deposit on the mudflat and stay there without being constantly resuspended- could be stabilized by algal mats.

What is responsible for the expansion of densiflora? Increased nitrogen? Other changes?

\$5-10K/ac is the current cost of mowing control at the refuge.

What are the effects on net primary productivity of removing Spartina?

What is the influence of mycorrhizae in the HB marshes, and how would they be affected by Spartina removal? Are there mycorrhizae specific to Spartina and others specific to the native species?

What is the effect of spartina removal on benthic microorganisms?

The importance of centralized management for effective control of Spartina was stressed.

Topic 3: *Spartina* management options.

Overall Question: What are the options for *Spartina* management? Are there options that should be considered aside from taking no action or attempting to eradicate invasive *Spartina* regionally? What level of control is appropriate to pursue given our current level of knowledge about the impacts of *Spartina* and the impacts of *Spartina* eradication?

Aside from taking no action or eradicating *Spartina* from the region, what other options for *Spartina* management do you believe are worth considering? What are the pros and cons of these options, taking into account our current level of knowledge?

Management Option	Rank
1. Eradicate <i>Spartina</i> from high elevation salt marsh and conduct ongoing control efforts to prevent re-invasion.	
2. Identify highly sensitive native plant areas and conduct ongoing monitoring and control to protect them from invasive <i>Spartina</i> .	
3. Monitor invasive <i>Spartina</i> and initiate control efforts if it appears to be spreading into new biological communities (e.g. brackish marsh, fresh marsh, grasslands).	
4. Regional Eradication	
5. No Action	

Management Option	Rank
4. Mechanical Control Only	
5. _____	
6. _____	

List some pros and cons associated with the management approaches above. Discuss the pros and cons of conducting more research before moving forward with eradication or other management.

Management Approach

Pros

Cons

1. Eradicate *Spartina* from high elevation salt marsh and conduct ongoing control efforts to prevent re-invasion.
2. Identify highly sensitive native plant areas and conduct ongoing monitoring and control to protect them from invasive *Spartina*.
3. Monitor invasive *Spartina* and initiate control efforts if it appears to be spreading into new biological communities (e.g. brackish marsh, fresh marsh, grasslands).
4. Regional Eradication
5. No Action

Questions raised by this group:

What is the role of disturbance in opening areas for recolonization? If control is complete, disturbance is not a big problem, based on experience in Willapa.

Need to understand environmental context.

Most mechanical control not successful in Willapa.

If goal is to eradicate from HB, need to use all available tools.

Tidal elevation in diked baylands is an issue for restoration projects- *Spartina* will get there first.

Climate change will affect management- how will it impact HB?

Will other *Spartina* species migrate here? Is that desirable?

Need to make sure that human activities don't bring in other invasives.
Think about timing of herbicide application- experiment with native plant dormancy and rainfall periods.

In Willapa, they sprayed at high tides.

Are there major seed production areas that should be attacked first? Check Kittelson research (1997) to see if it indicates anything about where these would be.

A coastwide approach is needed.

The FWS Refuge feels that one reason to control densiflora now is that sea level rise will make the marshes move inland- we don't want these new areas to get infested.

Herbicide use will be opposed by some groups.

What are the alternatives to toxics- is there any info on control from Chile?
Biocontrols can be as risky or more than herbicide, and there is a long testing process.

If eradication is the goal, then biocontrol won't work. But it has succeeded with some species at reducing the invasive to a level where it does not dominate and its economic impacts are reduced significantly.

So if management of the species is the goal, then biocontrol could work.

There will need to be multiple meetings to explain the initiative to agencies and to the community.

There needs to be an integrated management approach, using mechanical control as well as herbicide. Pick the low hanging fruit first.

Could mow first and then apply herbicide on stems.

New herbicide- Imazapox (Clearcast)- is now available. Marine reg this spring. Less toxic and has no persistence issue. Its effect on Spartina is unknown.

It is possible that Spartina could develop resistance to herbicide over time. Eradication is preferred over control, but chemical use will be controversial. Oyster farms (ok in Willapa) could be concerned.

Obtaining a permit for the control/spraying program would be a long term process.

Start small with pilot projects.

Perhaps start small with manual efforts to minimize seed output while the rest of the program develops.

Get info on bird use of restoration sites.

Need to understand how to protect new restoration areas from invasion- e.g. McDaniel/Freshwater Slough. Mow nearby seed sources, use booms, create a gradient change so site is well enough drained. Make monitoring and control part of management plan for the restoration.

Topic 4: *Working with the Community.*

Overall Question: Who should come together in the Humboldt Community to discuss *Spartina* management options? Who has a stake in the question? How do different groups' interests in the issue differ?

Question 1: Who are the key stakeholders in *Spartina* management? What are their concerns/interests in the issue (e.g. biodiversity protection, concerns about herbicides)? Would it be easy or hard to get this group involved? What might make it easier to involve them?

A list of types of stakeholders that were contacted for this summit is attached to provide a starting point.

Best ways to involve the community-

Stress that this is a marsh restoration project, not just a *Spartina* eradication project.

Provide an explicit overview of impacts of *Spartina* on the ecosystem. Build a strong case for action.

Provide a forum for public input.

Demonstrate the benefits of restoration.

Educate the public about salt marsh in general.

Develop a draft management plan

Collect data on controlled test plots.

Provide tours community by community.

Develop a steering committee.

Conduct outreach to oystergrowers and other groups.

Find a champion for this issue!

Question 2: If the concerns/interests of some stakeholder groups conflict, what might be some strategies to achieve compromise? Are there concerns that can't be addressed in the context of a *Spartina* eradication effort?

Spartina Summit Group Discussion Worksheets

Groups

Key Issues/Concerns

1. Federal Regulatory and Land Management Agencies
(e.g. US Fish and Wildlife Service, Bureau of Land Management, ACOE, EPA, NMFS, NRCS)
2. State Regulatory and Land Management Agencies
(e.g. CA Dept of Fish and Game, North Coast Regional Water Board, Coastal Commission, Ag Extension, HSU)
3. Local Government Agencies
(e.g. Bayside Cities, Humboldt Bay Harbor, Rec and Conservation District, Cty supervisors, WMA, School District)
4. Community Groups
(e.g. Californians for Alternatives to Toxics, HB Watershed Advisory Committee, Audubon, Sierra Club, NEW, Baykeeper, CNPS, NP. Restoration Grps, TNC, Chamber of Commerce)
5. Ranchers
6. Other Private Salt Marsh Landowners
7. Academic Institutions (Humboldt State, College of the Redwoods)
8. Hunters and hunting groups
9. Oyster/Aquaculture industry
10. Commercial Fishermen
11. Native American Groups
12. Land Trusts
13. Media

Spartina Summit Group Discussion Worksheets

14. Larger community- Oregon and Washington

13.

14.